Spring 2004

Physics 137B Section 1: Problem Set #5
Due: 5PM Friday March 5 in the appropriate dropbox inside 251 LeConte (the "reading room")

Suggested Reading for this Week:

- Bransden and Joachain (B& J) Section 8.3
- B& J Section 10.1 through 10.4

Note: Homework on the "sudden approximation," which was covered in class last Wed will appear on the next homework.

Homework Problems:

1. B& J Problem 8.13
2. The following problems require that you use the properties of identical fermions or bosons under particle interchange. In all the parts below, assume the particles are placed in a one dimensional infinitely deep square well of width L.

   (a) Consider a system with 2 neutrons and one proton. Find the energy and degeneracy of the ground state and first excited state and write wave functions for these states. Make sure your wave functions have the appropriate behavior under interchange of identical particles. You may assume that the 3 particles in this problem do not interact with each other.

   (b) Repeat part (a) for a system with 2 π^0 and and one π^+ (the π has spin=0).

   (c) Suppose we now have a system with 5 neutrons and 3 protons. What is the ground state energy? (You do NOT need to write down the wave function)

(d) Now, assume we have a system with 8 π^0 and 3 π^+. Find the ground state energy in this case. (Once again, You do NOT need to write down the wave function)

3. Suppose we have spin 1/2 fermions that can be on one of 3 orthogonal states that we will call $|\alpha\rangle$, $|\beta\rangle$ and $|\gamma\rangle$. If we have a system of 3 such fermions, there is only one possible state that is totally antisymmetric under interchange. Use the method of the Slater Determinant to find that state.

4. B& J Problem 10.3

5. B& J Problem 10.4